Snake River Sediment Permeability Study

Work Plan

Fall 2000

Introduction and objective

The objective of this study is to estimate sediment permeability within areas where fall chinook salmon currently spawn in the Hells Canyon Reach of the mainstem Snake River. This information will be compared to the results from a recently completed similar study of historic fall chinook salmon spawning areas in the upper Snake River. Although sediment permeability is variable through time (e.g. changing bedforms or intrusion of fines into existing redds), this comparison of the historic use areas to current use areas will help IPC evaluate the potential to reintroduce fall chinook salmon upstream of the Hells Canyon Dam.

General logistics

The field work for this project will correspond to a four-day-period (September 27-30, 2000) when discharge of the Snake River within the Hells Canyon Reach will be lowered to 5,000 cfs. This flow reduction is being conducted in order to calibrate hydraulic models. The low-flow condition provides an excellent opportunity to collect freeze-core samples from the river channel. The study sites will correspond to four sites in the Hells Canyon Reach that fall chinook salmon presently spawn (tentative dates): Wild Sheep (9/27), Suicide Point or Kirby Creek (9/28), Robinson Gulch (9/29), and Rivermile 152 (9/30). While working in the upper river (9/26, 9/27, 9/28, and 9/29), we will stay three nights at Kirby Creek which provides meals, beds, and shower/toilet facilities. We will stay in Lewiston, Idaho 9/29 and 9/30 (if needed).

During the work in the upper river, IPC will provide two boats, drivers, and a couple staff to assist Battelle. On Saturday, 9/30, IPC will provide one boat and a driver; Battelle will provide the second boat.

The liquid nitrogen will be stored at Pittsburg Landing in large (260 L) dewars. Each day, we will fill three 35 L dewars and a couple smaller dewars for that days freeze coring.

Methods

We will use direct and indirect measurements of sediment permeability within current fall chinook salmon spawning areas. Best efforts will be made to ensure that permeability measurements are taken within habitat that salmon are presently using. In other words, we will confine our measurements to areas that are within the range of habitat use for adult fall chinook salmon (Groves and Chandler 1999). Since substrate maps are not available for all sites, we will rely on IPC staff to assist us in determining the range of available substrate and the appropriate sample locations. At each site IPC staff will identify 15 randomly chosen sampling locations from the population of all available and appropriate (e.g., substrate, depth) sampling locations. Five of the fifteen locations will be used for sediment core sampling and for slug testing. An additional five locations will be used for additional slug testing, and five locations will be used as backup in the event that micro-scale conditions at a given point are not conducive to sampling. All locations will be identified in the river through a combination of GPS navigation and the assistance of IPC staff.

Two approaches will be used to measure sediment permeability: freeze coring and slug testing.

NOTE: Before using either the freeze coring or slug testing methods, each individual must read, understand, and comply with all pertinent safety plans.

Freeze coring

At each study site, the 15 randomly chosen sampling points will be used to locate sediment coring points. Five (5) cores will be extracted from each of the four spawning sites, for a total of 20 sediment cores. The cores will be extracted using the following methods:

1. The tri-tube freeze core assembly (drive-tip tubes, upper and lower retainer plates) is placed on the channelbed surface at the sampling point. Retainer plates are adjusted before/during placement. The lower plate is adjusted to allow the tubes to penetrate into the channelbed to a depth of 30-50 cm. The upper plate is adjusted to allow for driving the tubes with a post-hole pounder.
2. One-by-one all tubes are driven into the channelbed to a depth pre-determined by the lower retainer plate (i.e., 30-50 cm). The tubes can be worked into the substrate by hand, hammer, and/or post-hole pounder. After all tubes are driven to the appropriate depth, the upper retainer plate may be adjusted upward to allow easier connection to the chain hoist for extraction.
3. Place the extraction tripod with chain hoist around the tri-tube assembly. Prepare the entire assembly for extraction – i.e., adjust height of tripod, connect chain hoist to upper retainer plate and adjust tension.
4. Prepare for pouring liquid nitrogen into the tri-tube assembly. Use a small-volume container (2-6 liters) for pouring liquid nitrogen into the tri-tubes (NOTE: the combined volume of all three tri-tubes is approximately 2.3 liters). The small-volume container may be pre-filled with liquid nitrogen, or it may have to be filled from a larger volume container stored on the boat, trailer, or truck, depending on the size of the larger container. If necessary, assemble a funnel and/or flexible tubes through which the liquid nitrogen will be poured into the tri-tube assembly.
5. Pour the liquid nitrogen through the funnel and/or flexible tubing, and into one or more of the tri-tubes, depending on the funnel/tubing used. The liquid nitrogen should be slowly poured into the funnel. Do not pour a volume of liquid nitrogen into the funnel that exceeds the combined initial capacity of all three tri-tubes (i.e., ~2.3 liters). After pouring the first small volume into the funnel, wait several minutes for the liquid nitrogen to volatilize, then pour another small volume into the funnel. If

necessary, repeat this procedure for each individual tube of the tri-tube assembly. The total volume of liquid nitrogen used for each core, and total elapsed time from pouring to core extraction, will depend on site-specific conditions and therefore be determined by trial and error.

6. Extract the frozen core from the riverbed by ratcheting the chain hoist. Once the core is removed, disconnect it from the chain hoist and carry it to the substrate stratification box.
7. Place the core on the box such that the core will be divided into two strata of predetermined lengths. These lengths will be determined in the field, with the upper strata representing the b-axis diameter of the largest clast sampled from the channelbed surface within the study area.
8. Photograph the core while it remains frozen and placed on top of the substrate box.
9. Thaw the core with a propane torch, portable heater, or other similar means. If necessary, make certain that thawed substrate particles fall into the appropriate chamber of the substrate box, depending on the strata determination.
10. Empty the contents of each chamber of the substrate box into a separate bag, resulting in two sample bags per freeze core. Note that usually there will be one bag per core as only one strata is used.
11. Label each sample according to the study site, sample location, and strata. Make a record in the data book for the completed core.
12. Using the GPS, record the location of the freeze core site.

Slug testing

At each study site, the 15 randomly chosen sampling points will be used to locate slug testing points. Ten (10) points will be tested for each spawning site, for a total of 40 slug testing points; at each site, 5 of the slug tests will occur in the same location as the sediment core sample. Several (2-4) slug tests will be performed at each testing point. The slug tests will be conducted using the following methods:

1. Install piezometers with post pounder or air hammer
   - 1.1. Step-ladder is set on the river bottom at the location where the piezometer will be installed. Alternatively, a boat can be used as the work platform. Water depth should not exceed four feet. One person will man the ladder while a second person will climb up the ladder carrying the post pounder or air hammer. Life jackets or a buoyancy compensating device shall be worn when installing piezometers. Life jackets are optional when sampling piezometers, unless you are working from a boat.
   - 1.2. A third person inserts the drive rod into the piezometer. This person then assists the post pounder or hammer operator in guiding the rod into the drive attachment and standing the piezometer up so that it is next to the ladder and comfortable for the post pounder or hammer operator. (Note: make sure that the distance from the top of the piezometer to the top of the screen and the length of the screen are recorded).

1.3. The compressor is started and the air turned on so that the hammer is live. All persons are wearing hand, eye and ear protection. The hammer is started and the piezometer is driven into the bed to the appropriate depth. For this study, the piezometer should be driven into the bed until the top of the screen is 30-50 cm below the channelbed surface.

1.4. The hammer is then taken off the drive-rod and set aside. The rod is removed from the piezometer. Pipe wrenches may be necessary for this.

1.5. The air to the hammer is turned off, pressure is taken off the hammer, and the hammer disconnected from the air line. A separate section of blank hose is attached to the air line and inserted into the piezometer. Air is turned on at low pressure and used to clean out the piezometer. This may take several minutes and is continued until the water coming out is relatively clear.

1.6. The distance from the top of the piezometer to the riverbed is determined. This is used to calculate the distance from the riverbed to the top of the screen. This number is recorded.

1.7. If necessary, a coupler(s) and extension(s) are added to the piezometer to extend the piezometer above the river surface. Pipe thread tape is used on the threads. Two wrenches are used to ensure connections are tight.

1.8. Water is poured into the piezometer to test whether the piezometer is in continuity with the river bed (water level will drop). Allow the water to re-equilibrate.

1.9. A preliminary measurement is taken of the distance from the top of the piezometer to the water level in the piezometer. The distance from top of piezometer to the river level is also measured. A separate pipe that is affixed to the piezometer is useful for this as it acts as a shield and creates a stilling basin. (Make sure that the measurement is made to the top of the piezometer, not the stilling pipe.) These measurements are made using an E-tape. Results are recorded on data sheet.

1.10. Record the location of the piezometer using the GPS.

2. Perform the slug test

2.1. Connect and setup the pressure transducer, data logger, and laptop computer.

2.2. Thread the pressure transducer and cable through the pressurizing assembly (PVC coupler with ball release valve, pressure hose/inflator fitting), being certain to create a good seal where the cable threads through the rubber stopper. Set the pressure transducer such that the terminal end is placed at the top of the piezometer screen.

2.3. Thread the pressurizing assembly onto the piezometer, being certain to create a good seal on the pipe threads.

2.4. Confirm that the data logger software is properly configured and prepared to log data.

2.5. Connect a portable inflator to the inflator fitting on the pressurizing assembly. Start the inflator to begin pressurizing the piezometer, introducing a slug of air, and displacing a volume of water. After the appropriate time has elapsed (determined by trial and error) and a sufficient volume of water has been displaced, turn off the inflator and open the ball release valve. Turning off the inflator and opening the ball release valve should occur simultaneously.

2.6. View the piezometer recovery time on the laptop computer, and save the data file to the hard drive.
2.7. Copy the data file to a floppy disk.
2.8. Perform additional slug tests on the piezometer as necessary.